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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/735,845	12/16/2003	Chih-Chao Yang	20140-00314-US	3180

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EXAMINER


TRAN, THANH Y

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 09/06/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/735,845	Applicant(s) YANG ET AL.	
	Examiner Thanh Y. Tran	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 July 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) 12-23 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>12/16/03</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Applicant's election of group I (claims 1-11) in the reply filed on 7/26/05 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Objections

1. Claim 2 is objected to because of the following informalities: claim 2 is unclear because it does not recite which material is selected to use for forming the conductive line. For the purpose of examining, the examiner assumes that the provided conductive line is selected from the group consisting of at least one of TaN, Ta, Ti, Ti(Si)N, Au, Ag, Ru, W, Cu, Al, and Al(Cu)_x(Si)_y. Appropriate correction is required.
2. Claim 7 is objected to because of the following informalities: claim 7 is unclear because it does not recite which material is selected to use for the sacrificial layer. For the purpose of examining, the examiner assumes that the sacrificial layer is a material selected from the group consisting of at least one of silicon oxides, silicon nitrides, silicon carbides, tetrafluoro-poly-p-xylylene, poly(arylene ethers) and cyclotene. Appropriate correction is required.
3. Claim 5 is objected to because of the following informalities: there an error in claim 5, line 2, "an" should be changed to: --a--. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 11 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

What applicant means by “the deposited interlayer would contact the dielectric”?

Claim 11 recites the limitation “the dielectric” in lines 2 and 3. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1- 4, 6-7, and 9-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Cooney (2004/0152295).

As to claim 1, Cooney discloses in figures 1A-1F a structure and a corresponding method of making an interconnect structure comprising: providing a conductive line (“second liner layer” 9) (see paragraph [0024]) in a dielectric trench (5), wherein the conductive line (“second liner layer” 9) is in contact with a cap layer (“metal line” 2); depositing a sacrificial layer (“silicon nitride layer” 3) on the cap layer (“metal line” 2); depositing an interlayer dielectric (4) on the sacrificial layer (“silicon nitride layer” 3); forming a trench (a trench is a top opening part of “via” 5 in dielectric 4) and a via (a via is a bottom opening part of “via” 5 in dielectric 4) in

Art Unit: 2822

the interlayer dielectric (4), wherein the via bottom extends to the sacrificial layer ("silicon nitride layer" 3); and removing a portion of the cap layer ("metal line" 2) and the sacrificial layer ("silicon nitride layer" 3) proximate to the bottom surface of the via (see figures 1C-1F), wherein the removed portions of the cap layer ("metal line" 2) and the sacrificial layer ("silicon nitride layer" 3) deposit predominantly along the lower sidewalls of the via.

As to claim 2, Cooney discloses in figures 1A-1F a structure and a corresponding method of making an interconnect structure, wherein the provided conductive line ("second liner layer" 9) is selected from the group consisting of at least one of TaN, Ta, Ti, Ti(Si)N, Au, Ag, Ru, W, Cu, Al, and $\text{Al}(\text{Cu})_x(\text{Si})_y$ (see "tantalum" or "titanium" in paragraph [0024]).

As to claim 3, figure 1C of Cooney shows the deposition of a barrier layer ("first liner layer" 6) on upper and lower sidewalls and bottom surface of the trench and via in the interlayer dielectric (4).

As to claim 4, figure 1C of Cooney shows the remove of a portion of the barrier layer ("first liner layer" 6) at the bottom surface of the via, wherein the removed portions of the barrier layer ("first liner layer" 6) deposit predominantly along the lower sidewalls of the via.

As to claim 6, figures 1E-1F of Cooney shows deposition of a metal liner or a seed layer ("second liner layer" 9) in contact with the barrier layer ("first liner layer" 6).

As to claim 7, Cooney discloses in figures 1A-1F a structure and a corresponding method of making an interconnect structure, wherein the sacrificial layer ("silicon nitride layer" 3) is a material selected from the group consisting of at least one of silicon oxides, silicon nitrides, silicon carbides, tetrafluoro-poly-p-xylylene, poly(arylene ethers) and cyclotene (see "silicon nitride" layer 3 in paragraph [0020]).

As to claim 9, Cooney discloses in figures 1A-1F a structure and a corresponding method of making an interconnect structure, wherein the provided conductive line ("second liner layer" 9) (see paragraph [0024]) and the cap layer ("metal line" 2) are recessed in the dielectric trench (5).

As to claim 10, Cooney discloses in figures 1A-1F a structure and a corresponding method of making an interconnect structure, wherein the sacrificial layer ("silicon nitride layer" 3) is recessed in the dielectric trench (5).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cooney (2004/0152295) in view of Spencer et al (U.S. 6,060,019).

As to claim 5, Cooney does not disclose a structure and a corresponding method, wherein removing a portion of the cap layer and the sacrificial layer is conducted by a gaseous ion bombardment.

Spencer et al discloses in col. 2, lines 27-38 a method of using a gaseous ion bombardment for removing the surface layers of the material. Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the structure and the corresponding method of Cooney by using a gaseous ion bombardment for

removing the surface layers of the material as taught by Spencer et al for preventing the damage to the substrate or the structure.

10. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cooney (2004/0152295) in view of Lee et al (U.S. 2003/0104704).

As to claim 8, Cooney does not disclose a structure and a corresponding method, wherein the sacrificial layer is a material selected from the group consisting of at least one of tantalum nitride, tantalum, titanium silicon nitride, titanium, tungsten nitride and tungsten.

Lee et al discloses in figure 3A a structure and a corresponding method, wherein the sacrificial layer (63A) is a material selected from the group consisting of at least one of tantalum nitride, tantalum, titanium silicon nitride, titanium, tungsten nitride and tungsten (see "tungsten" material used for sacrificial layer (63A) in paragraph [0066]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the structure and corresponding method of Cooney by using tungsten material for a sacrificial layer as taught by Lee et al for providing an etching gas layer.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kim et al (U.S. 6,855,629), Meagley et al (U.S. 2004/0183203), Chan et al (U.S. 6,312,874), and Chiras et al (U.S. 2005/0118796) disclose relevant prior arts to the invention.


Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Y. Tran whose telephone number is (571) 272-2110. The examiner can normally be reached on M-F (9-6:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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